Conditions of Equilibrium for Macro Inhomogeneous Systems Under Gravity Near the Critical Point

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On the basis of the contemporary fluctuation theory of phase transitions (FTPT) [1] a substance near the critical point (CP) is a gas of the clusters of fluctuations. The compressibility of a system goes to infinity near the CP. In this case the characteristics of the substance (a correlation length R_c, a mass of the cluster of the fluctuation $m_f=4/3\times\pi R_c^3\rho_f$) change along the height of a system [2] in the external field $h=\rho_c g\Delta z\times P_c^{-1}$. The condition of equilibrium [3] $|\Delta\mu=(\mu-\mu_c)/\mu_c|=| h=\rho_c g\Delta z\times P_c^{-1}|$ (1) cannot be considered as correct one for such real system under gravity near the CP. The experimental studies of such inhomogeneous systems [2] showed [2,4] that the action of the gravity field of the Earth causes the appearance of the internal nonuniform field U (h) in the inhomogeneous liquid at the critical state. It changes in the range of heights $\Delta U(h)=\Delta\mu(h)= (10\text{-}10^2)h >> h$. It has been for the first time obtained [2,4] that the value of this internal field ($|\Delta\mu(h)|>>|h|$) depends:

a) on the critical temperature of substance ($\Delta U(T_c)=\Delta\mu(T_c)\sim T_c^3$);
b) on the linear size of the system ($\Delta U(L)=\Delta\mu\sim f(L)\sim L^{-x}$);
c) on the average density ρ_a of a system filling with the substance $\Delta U(\rho_a)=\Delta\mu(\rho_a)=f(\rho_a)$.

Hence it follows that the condition of the equilibrium of an inhomogeneous substance under the gravity field of the Earth is different from [1], namely $|\Delta\mu=(\mu-\mu_c)/\mu_c| = |\Delta U(T_c,L,\rho_a)|>>|h|$ [2]. It means that the condition of equilibrium for the inhomogeneous substance depends on the vicinity of the system to the critical state.

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